

In step S420, the CPU 101 checks whether the calculated rotational speed  $r$  is higher than the predetermined rotational speed  $r_2$ . If the rotational speed  $r$  is equal to or lower than the predetermined rotational speed  $r_2$ , the flow returns to step S310 in the flow chart of FIG. 11, and the CPU 101 resets the counter of the number of copies  $C$  and completes the process. If the rotational speed  $r$  is higher than the predetermined rotational speed  $r_2$ , the flow advances to step S422, and the CPU 101 displays near empty. The flow then returns to step S310 in the flow chart of FIG. 11, and the CPU 101 resets the counter of the number of copies  $C$  and completes the process.

In the third embodiment described above, the remaining toner amount can be detected in real time. Also, the remaining toner amount can be displayed in the state of near empty which is close to empty.

Each of the above embodiments is merely an example and hence does not restrict the present invention. The present invention can be modified without departing from the scope of right of the invention. For example, the outer shape of the toner bottle and the arrangement of the driving unit are not limited to those shown in FIGS. 1 to 3. Also, the shape of the rib formed on the outer surface of the toner bottle is not restricted to the one shown in FIGS. 2 to 5 and can be deformed where necessary. In the second embodiment described above, both the toner stirring process and the toner bottle type discrimination process are performed. However, only the toner stirring process can also be performed.

Furthermore, when the CPU checks whether a toner bottle is a genuine product or whether toner is near empty, the result can be displayed on a dedicated screen or a screen for operations, such as a liquid crystal display or a CRT, commonly included in a copying machine.

What is claimed is:

1. A method of discriminating toner bottle types, comprising:

the object sensing step of rotating a toner bottle, sensing an object to be sensed formed on an outer surface of said toner bottle and, if said object is not sensed, outputting information indicating abnormality; and

the ratio discrimination step of checking, if said object is sensed, whether said object is formed at a predetermined ratio on the outer surface of said toner bottle, outputting information indicating abnormality if said object is not formed at the predetermined ratio, and outputting information indicating normality if said object is formed at the predetermined ratio.

2. A method according to claim 1, wherein the object ratio discrimination step comprises the steps of:

detecting a first time interval from the timing at which said sensor senses one end portion of said object of said toner bottle in rotation to the timing at which said sensor senses the other end portion;

detecting a second time interval from the timing at which said sensor senses the other end portion of said object to the timing at which said sensor senses the one end portion; and

checking whether said object is formed over a predetermined length on the outer surface of said toner bottle by using the first and second time intervals.

3. A method according to claim 1, wherein the object ratio discrimination step is performed with reference to the timing at which a first end portion of said object of said toner bottle in rotation is sensed and the timing at which a second end portion of said object is sensed.

4. An apparatus for discriminating toner bottle types, comprising:

a motor for rotating a toner bottle;

a motor driver for driving said motor;

a sensor for sensing an object to be sensed formed in a predetermined portion of said toner bottle and outputting a sensor signal; and

a CPU for controlling said motor driver and discriminating said toner bottle by using the sensor signal,

wherein said CPU rotates said toner bottle by controlling said motor driver, senses said object assumed to be formed on an outer surface of said toner bottle by using said sensor, outputs information indicating abnormality if said object is not sensed,

checks, if said object is sensed, whether said object is formed at a predetermined ratio on the outer surface of said toner bottle, outputs information indicating abnormality if said object is not formed at the predetermined ratio, and outputs information indicating normality if said object is formed at the predetermined ratio.

5. An apparatus according to claim 4, wherein in order to check whether said object is formed at the predetermined ratio on the outer surface of said toner bottle,

said CPU detects a first time interval from the timing at which said sensor senses one end portion of said object of said toner bottle in rotation to the timing at which said sensor senses the other end portion,

detects a second time interval from the timing at which said sensor senses the other end portion of said object to the timing at which said sensor senses the one end portion, and

checks whether said object is formed at the predetermined ratio on the outer surface of said toner bottle by using the first and second time intervals.

6. A toner bottle adapted to fit an apparatus for discriminating toner bottle types, wherein

said toner bottle type discriminating apparatus comprises:

a motor for rotating a toner bottle;

a motor driver for driving said motor;

a sensor for sensing an object to be sensed formed in a predetermined portion of said toner bottle and outputting a sensor signal; and

a CPU for controlling said motor driver and discriminating said toner bottle by using the sensor signal, and

said CPU rotates said toner bottle by controlling said motor driver, senses said object assumed to be formed on an outer surface of said toner bottle by using said sensor, outputs information indicating abnormality if said object is not sensed,

checks, if said object is sensed, whether said object is formed at a predetermined ratio on the outer surface of said toner bottle, outputs information indicating abnormality if said object is not formed at the predetermined ratio, and outputs information indicating normality if said object is formed at the predetermined ratio.

7. A toner bottle according to claim 6, wherein in order to check whether said object is formed at the predetermined ratio on the outer surface of said toner bottle,

said CPU detects a first time interval from the timing at which said sensor senses one end portion of said object of said toner bottle in rotation to the timing at which said sensor senses the other end portion,

detects a second time interval from the timing at which said sensor senses the other end portion of said object to the timing at which said sensor senses the one end portion, and

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checks whether said object is formed at the predetermined ratio on the outer surface of said toner bottle by using the first and second time intervals.

8. A method of stirring toner and discriminating toner bottle types, comprising the steps of:

- rotating a toner bottle through a predetermined angle in a forward direction, sensing an object to be sensed assumed to be formed on an outer surface of said toner bottle and, if said object is not sensed, outputting information indicating abnormality; and
- rotating said toner bottle through a predetermined angle in a reverse direction, sensing said object by using said sensor and, if said object is not sensed, outputting information indicating abnormality,

wherein toner is stirred by rotating said toner bottle through the predetermined angles in the forward and reverse directions.

9. An apparatus for stirring toner and discriminating toner bottle types, comprising:

- a motor for rotating a toner bottle;
- a motor driver for driving said motor;
- a sensor for sensing an object to be sensed formed in a predetermined portion of said toner bottle and outputting a sensor signal; and
- a CPU for controlling said motor driver and receiving the sensor signal,

wherein said CPU controls said motor driver to rotate said toner bottle through a predetermined angle in a forward direction, senses said object assumed to be formed on an outer surface of said toner bottle by using said sensor, outputs information indicating abnormality if said object is not sensed,

rotates said toner bottle through a predetermined angle in a reverse direction, senses said object by using said sensor, and outputs information indicating abnormality if said object is not sensed.

10. A toner bottle adapted to fit an apparatus for stirring toner and discriminating toner bottle types, wherein said toner stirring and toner bottle type discriminating apparatus comprises:

- a motor for rotating a toner bottle;
- a motor driver for driving said motor;
- a sensor for sensing an object to be sensed formed in a predetermined portion of said toner bottle and outputting a sensor signal; and
- a CPU for controlling said motor driver and receiving the sensor signal, and

said CPU controls said motor driver to rotate said toner bottle through a predetermined angle in a forward direction, senses said object assumed to be formed on an outer surface of said toner bottle by using said sensor, outputs information indicating abnormality if said object is not sensed,

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rotates said toner bottle through a predetermined angle in a reverse direction, senses said object by using said sensor, and outputs information indicating abnormality if said object is not sensed.

11. A method of detecting the amount of remaining toner, comprising the steps of:

- rotating a toner bottle and sensing the rotational speed by using a sensor; and
- detecting the amount of remaining toner in said toner bottle on the basis of the sensed rotational speed,

wherein the step of sensing the rotational speed of said toner bottle comprises:

- rotating said toner bottle, sensing one end portion of an object to be sensed of said toner bottle by using said sensor, and detecting a first time interval from the timing of sensing to the timing at which said sensor senses the other end portion;
- detecting a second time interval from the timing at which said sensor senses the other end portion of said object to the timing at which said sensor senses the one end portion; and
- calculating the rotational speed of said toner bottle by using the first and second time intervals.

12. An apparatus for detecting the amount of remaining toner, comprising:

- a motor for rotating a toner bottle;
- a motor driver for driving said motor;
- a sensor for sensing an object to be sensed formed in a predetermined portion of said toner bottle and outputting a sensor signal; and
- a CPU for controlling said motor driver and detecting the amount of remaining toner by using the sensor signal,

wherein said CPU controls said motor driver to rotate said toner bottle by said motor and detects the amount of remaining toner in said toner bottle on the basis of the output sensor signal from said sensor.

13. An apparatus according to claim 11, wherein said CPU controls said motor driver to rotate said toner bottle by said motor, senses one end portion of said object of said toner bottle by using said sensor, detects a first time interval from the timing of sensing to the timing at which said sensor senses the other end portion,

- detects a second time interval from the timing at which said sensor senses the other end portion of said object to the timing at which said sensor senses the one end portion,
- calculates the rotational speed of said toner bottle by using the first and second time intervals, and detects the amount of remaining toner in said toner bottle on the basis of the calculated rotational speed.

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14. A toner bottle for use with an image forming apparatus to supply toner to the image forming apparatus when the toner bottle is rotated by the image forming apparatus, the image forming apparatus having a sensor that senses the toner bottle, comprising:

an elongated bottle body that houses toner, the bottle body having an edge portion and an end portion, the end portion being positioned opposite to the edge portion in an axial direction along the bottle body, and a groove extending around the outer surface of the bottle body and extending between the edge portion and the end portion;

a toner discharge port provided on the bottle body adjacent the edge portion, the toner being discharged from the discharge port when the toner moves toward the edge portion during toner bottle rotation; and

a rib having a predetermined length, the rib being provided on the outer surface of the bottle body adjacent the end portion, the rib being sensed by the sensor in the image forming apparatus during toner bottle rotation in order to judge whether the rib exists at a predetermined position and extends for a predetermined ratio on the outer surface of the bottle body, to thereby discriminate toner bottle type.

15. The toner bottle according to claim 14, wherein the rib extends in a circumferential direction along the outer surface of the bottle body.

16. The toner bottle of claim 15, wherein the rib is formed at a predetermined position on the bottle body relative to the toner discharge port, the rib being aligned with the toner discharge port in an axial direction along the bottle body.

17. The toner bottle according to claim 14, wherein the rib faces the sensor in the image forming apparatus during rotation of the toner bottle.

18. An image forming apparatus in combination with the toner bottle according to claim 14, the image forming apparatus comprising:

a motor for rotating the toner bottle;

a motor driver for driving the motor;

a sensor for sensing the rib of the toner bottle and outputting a sensor signal; and

a CPU that controls the motor driver and discriminates the toner bottle using the sensor signal,

wherein the CPU rotates the toner bottle by controlling the motor driver, senses the rib using the sensor, outputs information indicating abnormality if the rib is not sensed by the sensor,

checks, if the rib is sensed, whether the rib has the predetermined ratio on the outer surface of the bottle body, outputs information indicating abnormality if the rib does not extend for the predetermined ratio, and outputs information indicating normality if the rib extends for the predetermined ratio.

19. The image forming apparatus in combination with the toner bottle according to claim 18,

wherein in order to check whether the rib extends for the predetermined ratio on the outer surface of the bottle body,

the CPU detects a first time interval that is based on when the sensor senses a first rib end portion of the rib during toner bottle rotation to when the sensor senses a second rib end portion,

detects a second time interval that is based on when the sensor senses the second rib end portion of the rib during toner bottle rotation to when the sensor senses the first rib end portion, and

checks whether the rib extends for the predetermined ratio on the outer surface of the bottle body based on the first and second time intervals.

20. The image forming apparatus in combination with the toner bottle according to claim 18, wherein the CPU controls the motor driver to stop rotation of the toner bottle when the sensor finishes sensing the rib.

21. A toner bottle for use in an image forming apparatus having a toner bottle sensor, the toner bottle comprising:

an elongated cylindrical body portion having an outer surface;

at least one groove extending around the outer surface of the cylindrical body portion;

a first end portion at a first end of the cylindrical body portion;

a second end portion at a second end of the cylindrical body portion opposite the first end portion in an axial direction along the cylindrical body portion;

a toner discharge port positioned at the first end portion; and

an object formed at the second end portion, the object being used to be sensed by the toner bottle sensor of the image forming apparatus to discriminate toner bottle type.

22. The toner bottle of claim 21, wherein the object comprises at least one of a rib, a magnetic material, and an optically sensible mark.

23. The toner bottle of claim 22, wherein the object is a rib for use with the toner bottle sensor that senses the rib.

24. The toner bottle of claim 23, wherein the rib is formed at a predetermined position on the toner bottle relative to the toner discharge port.

25. The toner bottle of claim 24, wherein the toner discharge port is aligned with the rib in an axial direction along the cylindrical body portion.

26. The toner bottle of claim 25, wherein the first end portion has a diameter smaller than a diameter of the cylindrical body portion.

27. The toner bottle of claim 26, wherein the rib extends circumferentially for a predetermined angle relative to the outer surface of the cylindrical body portion.

28. The toner bottle of claim 27, wherein the predetermined angle is less than 90 degrees.

29. The toner bottle of claim 27, wherein the groove is a spiral groove that extends from adjacent the second end portion to adjacent the first end portion.

30. The toner bottle of claim 29, wherein the spiral groove extends continuously without breaks from adjacent the second end portion to adjacent the first end portion.

31. The toner bottle of claim 30, wherein the continuous spiral groove comprises a plurality of groove portions that extend parallel to one another in a direction circumferentially along the outer surface of the cylindrical body portion.

32. The toner bottle of claim 31, wherein the plurality of groove portions comprises a first groove portion, a second groove portion, and a third groove portion, wherein a first distance between the first groove portion and the second groove portion is equal to a second distance between the second groove portion and the third groove portion.

33. The toner bottle of claim 26, wherein the first end portion is configured to engage with a rotatable holder guide in the image forming apparatus.

34. An image forming apparatus in combination with a toner bottle according to claim 21.

35. A method of discriminating toner bottle types, comprising the steps of:  
providing a toner bottle, the toner bottle comprising:  
an elongated cylindrical body portion having an outer surface,  
at least one groove extending around the outer surface of the cylindrical  
body portion,  
a first end portion at a first end of the cylindrical body portion,  
a second end portion at a second end of the cylindrical body portion  
opposite the first end portion in an axial direction along the cylindrical body  
portion,  
a toner discharge port positioned at the first end portion, and  
an object formed at the second end portion on an outer surface of the  
toner bottle;  
rotating the toner bottle in an image forming apparatus;  
sensing, using a sensor in the image forming apparatus, the object while rotating  
the toner bottle and, if the object is not sensed, outputting information indicating  
abnormality; and  
discriminating toner bottle type by checking, if the object is sensed, whether the  
object extends for a predetermined ratio on the outer surface of the toner bottle, outputting  
information indicating abnormality if the object does not extend for the predetermined  
ratio, and outputting information indicating normality if the object extends for  
predetermined ratio.



36. The method of claim 35, wherein the object is a rib.

37. The method of claim 36, wherein the step of discriminating toner bottle type comprises:

detecting, during the step of rotating the toner bottle, a first time interval that is based on when the sensor senses a first rib end portion of the rib to when the sensor senses a second rib end portion,

detecting, during the step of rotating the toner bottle, a second time interval that is based on when the sensor senses the second rib end portion of the rib to when the sensor senses the first rib end portion, and

checking whether the rib extends for the predetermined ratio on the outer surface of the toner bottle based on the first and second time intervals.

38. The method of claim 36, wherein the rib is positioned at a predetermined position on the toner bottle relative to the toner discharge port, and the rib is axially aligned with the toner discharge port in a direction along the cylindrical body portion.

39. The method of claim 36, wherein the rib extends circumferentially for a predetermined angle relative to the outer surface of the cylindrical body portion.

40. An image forming apparatus toner bottle, comprising:  
an elongated body portion having an outer surface;  
a first end portion at a first end of the body portion;  
a second end portion at a second end of the cylindrical body portion opposite the  
first end portion in an axial direction along the body portion;  
a toner discharge port positioned at the first end portion;  
a spiral groove extending around the outer surface of the body portion from  
adjacent the second end portion to adjacent the first end portion; and  
a rib formed adjacent the second end portion at a predetermined position axially  
aligned with the toner discharge port along the body portion, the rib extending  
circumferentially along the outer surface of the body portion for a predetermined angle  
relative to the outer surface of the body portion.

41. The image forming apparatus toner bottle of claim 40, wherein the body  
portion is cylindrical, and  
wherein the spiral groove extends continuously without breaks from adjacent the  
second end portion to adjacent the first end portion, and comprises a plurality of groove  
portions that extend parallel to one another in a direction circumferentially along the outer  
surface of the cylindrical body portion.

42. The image forming apparatus toner bottle of claim 41, wherein the  
plurality of groove portions comprises a first groove portion, a second groove portion,  
and a third groove portion, wherein a first distance between the first groove

portion and the second groove portion is equal to a second distance between the second groove portion and the third groove portion.

43. The image forming apparatus toner bottle of claim 40, wherein the rib is capable of discriminating toner bottle type.

44. A toner bottle for use in an image forming apparatus having a toner bottle discriminator, the toner bottle comprising:

an elongated cylindrical body portion having an outer surface;

at least one groove extending around the outer surface of the cylindrical body portion;

a first end portion at a first end of the cylindrical body portion;

a second end portion at a second end of the cylindrical body portion opposite the first end portion in an axial direction along the cylindrical body portion;

a toner discharge port positioned at the first end portion; and

a rib formed at the second end portion, the rib being used by the toner bottle discriminator of the image forming apparatus to discriminate toner bottle type.

45. The toner bottle of claim 6, wherein the toner bottle further comprises:

an elongated cylindrical body portion having an outer surface;

at least one groove extending around the outer surface of the cylindrical body portion;

a first end portion at a first end of the cylindrical body portion;

a second end portion at a second end of the cylindrical body portion opposite the first end portion in an axial direction along the cylindrical body portion; and  
a toner discharge port positioned at the first end portion,  
wherein the object is formed at the second end portion.

46. The toner bottle of claim 45, wherein the object is a rib.

47. The toner bottle of claim 46, wherein the rib is formed at a predetermined position on the toner bottle relative to the toner discharge port.

48. The toner bottle of claim 47, wherein the toner discharge port is aligned with the rib in an axial direction along the cylindrical body portion.

49. The toner bottle of claim 48, wherein the first end portion has a diameter smaller than a diameter of the cylindrical body portion.

50. The toner bottle of claim 46, wherein the groove is a spiral groove that extends from adjacent the second end portion to adjacent the first end portion.

51. The toner bottle of claim 50, wherein the spiral groove extends continuously without breaks from adjacent the second end portion to adjacent the first end portion.

52. The toner bottle of claim 51, wherein the continuous spiral groove comprises a plurality of groove portions that extend parallel to one another in a direction circumferentially along the outer surface of the cylindrical body portion.

53. The toner bottle of claim 52, wherein the plurality of groove portions comprises a first groove portion, a second groove portion, and a third groove portion, wherein a first distance between the first groove portion and the second groove portion is equal to a second distance between the second groove portion and the third groove portion.

54. The toner bottle of claim 53, wherein the toner discharge port is positioned on an outer circumferential surface of the first end portion.